

CLAIMS

1. A polarizer, including at least one birefringent layer, characterized in that at least one birefringent layer is the anisotropically absorbing one and has at least one refraction index that grows as the polarized light wavelength increases.
2. The polarizer according to claim 1, characterized in that at least one birefringent anisotropically absorbing layer has at least one refraction index that is directly proportional to the polarized light wavelength.
3. The polarizer according to claim 1, characterized in that at least one birefringent anisotropically absorbing layer has a thickness, whereat the interference extremum at output of the polarizer is realized for at least one linearly-polarized light component.
4. The polarizer according to claim 3, characterized in that thickness of at least one birefringent anisotropically absorbing layer satisfies the condition of obtaining, at output of the polarizer, the interference minimum for one linearly-polarized light component and the interference maximum for other orthogonal linearly-polarized light component.
5. The polarizer according to claim 1, characterized in further comprising at least one optically isotropic layer, whose refraction index coincides with, or maximally proximate to one of indices of the birefringent layer.
6. The polarizer according to claim 1, characterized in further comprising at least one birefringent layer, one refraction index of which layer coincides with, or maximally proximate to one of indices of the birefringent anisotropically absorbing layer, and the second refraction indices of the birefringent layer and birefringent anisotropically absorbing layer differ from one another.
7. The polarizer according to claim 1, characterized in that at least one birefringent anisotropically absorbing layer comprises at least two fragments of an unspecified shape, that differ from one another with respect of colour and/or the polarization axis direction.
8. The polarizer according to claim 7, characterized in further comprising at least one birefringent anisotropically absorbing layer comprising at least two fragments of an unspecified shape that differ from one another with respect of colour and/or the polarization axis direction.

09367543-11999

Sub
Q1

9. The **polarizer** according to claim 8, characterized in that between two birefringent anisotropically absorbing layers said polarizer further comprises layers of transparent, colourless or dyed materials.
10. The **polarizer** according to claim 1, characterized in further comprising an orienting layer formed of non-organic materials and/or different polymer materials.
11. The **polarizer** according to claim 1, characterized in further comprising a light-reflecting layer.
12. The **polarizer** according to claim 11, characterized in that the light-reflected layer is metallic.
13. The **polarizer** according to claim 1, characterized in that at least one birefringent anisotropically absorbing layer is formed on surface of a substrate.
14. The **polarizer** according to claim 13, characterized in that said polarizer as the substrate, comprises a birefringent plate or film, at least one birefringent anisotropically absorbing layer being formed at angle of 45° to the main optical axis of said plate or film.
15. A **polarizer**, including:
- a polarizing means for dividing a plurality of non-polarized light beams, constituting the light incident on the polarizer, into the same plurality of identical pairs of differently polarized light beams, and
 - means for changing polarization of at least one plurality of the identically polarized light beams comprised by said plurality of pairs of differently polarized light beams, the polarizing means being implemented in the form of focusing optical elements optically registered with the means for changing polarization and comprising at least one birefringent layer adjacent to at least one optically isotropic layer, *characterized* in that at least one birefringent layer is the anisotropically absorbing one and has at least one refraction index that grows as the polarized light wavelength increases.
16. The **polarizer** according to claim 15, characterized in that at least one birefringent anisotropically absorbing layer is implemented in the form of a set of volume or phase lenses.
17. The **polarizer** according to claim 15, characterized in that the focusing optical element is implemented in the form of a zone plate.

09367543-111999

Sub
a'

- 09367543-11999 Sub a'
18. The **polarizer** according to claim 17, characterized in that the zone plate is implemented in the form of an amplitude zone plate, even zones of which comprise at least one birefringent anisotropically absorbing layer adjacent to at least one optically isotropic layer, and the odd zones are made of the optically isotropic material.
 19. The **polarizer** according to claim 17, characterized in that the zone plate is implemented in the form of a phase zone plate, at least one refraction index of which phase zone plate changing along at least one of directions according to a certain rule, including in a non-monotonic manner.
 20. The **polarizer** according to claim 15, characterized in that the means for changing polarization comprises a sectioned translucent birefringent anisotropically absorbing layer having at least one refraction index that grows as the polarized light wavelength increases.
 21. The **polarizer** according to any one of claims 15-20, characterized in that the means for changing polarization is implemented in the form of a sectioned translucent half-wave birefringent plate or layer having sections disposed in focuses or outside focuses of the focusing optical elements.
 22. The **polarizer** according to any one of claims 15-20, characterized in that the means for changing polarization is implemented in the form of a sectioned translucent birefringent plate having sections in the form of quarter-wave plates disposed outside focuses of the focusing optical elements, and sections in the form of plates determining a phase difference between the ordinary and extraordinary rays, which phase difference differs by π from the phase difference determined by said sections in the form of quarter-wave plates disposed in focuses of the focusing optical elements.
 23. The **polarizer** according to any one of claims 15-20, characterized in that the means for changing polarization is implemented in the form of a sectioned translucent polymerized planar layer of a liquid crystal having the twist structure, with rotation of the optical axis of the liquid crystal within thickness of said layer at angle of 90° , with sections disposed in focuses or outside focuses of the focusing optical elements.
 24. The **polarizer** according to any one of claims 15-20, characterized in that the means for changing polarization is implemented in the form of sectioned translucent achromatic birefringent plate.

25. A **polarizer**, including means for converting an incoming non-polarized light into a plurality of identical light beams, a polarizing means for dividing non-polarized light beams into polarized passing and reflected light beams having different polarizations, and a means for changing polarization and direction of the light beams reflected from the polarizing means, *characterized* in that said polarizer is implemented in the form of at least one film of plate, whereon applied are said means, the polarizing means comprising at least one birefringent anisotropically absorbing layer having at least one refraction index that grows as the polarized light wavelength increases, or a birefringent layer having the constant, across the layer thickness, directions of the optical axes, or a birefringent layer having optical axes that change across the layer thickness according to a certain rule.
26. The **polarizer** according to claim 25, characterized in that the means for changing polarization and direction of the reflected light beams has a sectioned metallic mirror.
27. The **polarizer** according to any one of claims 25-26, characterized in that the polarizing means comprises at least one birefringent anisotropically absorbing layer or birefringent layer having the constant, across the layer thickness, directions of the optical axes, and comprising a quarter-wave plate upstream of the sectioned metallic mirror.
28. The **polarizer** according to any one of claims 25-26, characterized in comprising at least one layer of a cholesteric liquid crystal as at least one birefringent layer having directions of the optical axes that change across the layer thickness according to a certain rule.
29. The **polarizer** according to claims 28, characterized in that at least one layer of a cholesteric liquid crystal is made of a polymer cholesteric liquid crystal.
30. The **polarizer** according to claim 28, characterized in that at least one layer of a cholesteric liquid crystal has, across the thickness, a gradient of the cholesteric spiral pitch and, as the result, has the spectrum width of the light selective reflection band of not less than 100 nm.
31. The **polarizer** according to claim 28, characterized in comprising at least three layers of cholesteric liquid crystals having the light selective reflection bands in three different spectrum ranges.

09367543-11999

Sub
a1

32. The **polarizer** according to any one of claims 25-26, characterized in that the means for converting the incoming non-polarized light is implemented in the form of a system of microlenses or microprisms focusing the light beams coming out of them in the direction towards interior of the polarizer.
33. The **polarizer** according to claims 32, characterized in that the system of microlenses is implemented in the form of positive cylindrical microlenses that completely cover the surface of the polarizer.
34. The **polarizer** according to claim 26, characterized in that on a first surface of a film or plate it comprises a system of microlenses and a sectioned metallic mirror optically registered with said system of microlenses, and on a second surface of a film or plate it comprises at least one layer of a cholesteric liquid crystal.
35. The **polarizer** according to claim 26, characterized in that on the first surface of a film or plate it comprises a system of microlenses, a sectioned metallic mirror optically registered with said system of microlenses, and a quarter-wave plate, and on the second surface it comprises at least one birefringent anisotropically absorbing layer or birefringent layer having the constant, across the layer thickness, directions of the optical axes.
36. The **polarizer** according to claim 26, characterized in that on the first surface of a film or plate it comprises a sectioned metallic mirror, and on the second surface of a film or plate sequentially applied are a system of microlenses optically registered with sections of the metallic mirror, and at least one layer of a cholesteric liquid crystal.
37. The **polarizer** according to claim 26, characterized in that on the first surface of a film or plate it comprises a sectioned metallic mirror and a quarter-wave plate, and on the second surface of a film or plate sequentially applied are a system of microlenses optically registered with sections of the metallic mirror, and at least one birefringent anisotropically absorbing layer or birefringent layer having the constant, across the layer thickness, directions of the optical axes.
38. The **polarizer** according to claim 26, characterized in comprising at least two laminated films or plates, on the external surface of a first film or plate applied is a first system of microlenses, on the internal surface of a first or second film or plate applied is a sectioned metallic mirror, and on the external surface of the second film or plate

09367543-11999

Sub
a

additionally applied are a second system of microlenses optically registered with sections of the metallic mirror and with the first system of microlenses, and at least one layer of a cholesteric liquid crystal.

39. The **polarizer** according to claim 26, characterized in comprising at least two laminated films or plates, on the external surface of the first film or plate applied is the first system of microlenses, on the internal surface of the first or second film or plate applied are the sectioned metallic mirror and the quarter-wave plate, on the external surface of the second film or plate additionally applied are the second system of microlenses optically registered with sections of the metallic mirror and with the first system of microlenses, and at least one birefringent anisotropically absorbing layer or birefringent layer having the constant, across the layer thickness, directions of the optical axes.
40. The **polarizer** according to claim 26, characterized in comprising at least two laminated films or plates, on the external surface of the first film or plate applied is a system of microprisms, on the internal surface of the first or second film or plate applied is a sectioned metallic mirror optically registered with the system of microprisms, on the external surface of the second film or plate applied are is one layer of a cholesteric liquid crystal.
41. The **polarizer** according to claim 26, characterized in comprising at least two laminated films or plates, on the external surface of the first film or plate applied is a system of microprisms, on the internal surface of the first film or plate sequentially applied are the sectioned metallic mirror optically registered with the system of microprisms, a quarter-wave plate, on the external surface of the second film or plate applied is at least one birefringent anisotropically absorbing layer or birefringent layer having the constant, across the layer thickness, directions of the optical axes.
42. The **polarizer** according to any one of claims 15-20, 25, 35, 37, 39, 41, characterized in that at least one birefringent anisotropically absorbing layer has at least one refraction index that is directly proportional to the polarized light wavelength.
43. The **polarizer** according to any one of claims 15-20, 25, 35, 37, 39, 41, characterized in that at least one birefringent anisotropically absorbing layer has the thickness whereat

09367543-11999

Sub
a1

realized is the interference extremum at output of the polarizer at least for one light linearly-polarized component.

44. The **polarizer** according to claim 43, characterized in that thickness of at least one birefringent anisotropically absorbing layer satisfies the condition of obtaining, at output of the polarizer, the interference minimum for one linearly-polarized light component and the interference maximum for the other orthogonal linearly-polarized light component.

45. The **polarizer** according to any one of claims 15-20, 25, 35, 37, 39, 41, characterized in that the polarizing means comprises at least two layers, of which layers at least one of them is a birefringent anisotropically absorbing layer, and the other is an optically isotropic layer, whose refraction index coincides with, or maximally proximate to one of indices of the birefringent layer.

46. The **polarizer** according to any one of claims 15-20, 25, 35, 37, 39, 41, characterized in that the polarizing means comprises at least two birefringent layers, of which layers one of them is the anisotropically absorbing layer, one refraction index of which layer coincides with, or maximally proximate to one of indices of the birefringent layer, and the second refraction indices of the birefringent layer and birefringent anisotropically absorbing layer differ from one another.

47. The **polarizer** according to any one of claims 15-20, 25, 35, 37, 39, 41, characterized in that at least one birefringent anisotropically absorbing layer is formed:

- of at least one organic salt of a dichroic anionic dye having general formula:
 $\{\text{Chromogene}\} - (\text{XO}^-\text{M}^+)_n$, where Chromogene is a dye chromophore system; $\text{X} = \text{CO}$, SO_2 , OSO_2 , $\text{OPO}(\text{O}^-\text{M}^+)$; $\text{M} = \text{RR}'\text{NH}_2$; $\text{RR}'\text{R}''\text{NH}$; $\text{RR}'\text{R}''\text{R}^+\text{N}$; $\text{RR}'\text{R}''\text{R}^+\text{P}$, when R , R' , R'' , $\text{R}^+ = \text{CH}_3$, ClC_2H_4 , C_2H_5 , C_3H_7 , C_4H_9 , $\text{C}_6\text{H}_5\text{CH}_2$, substituted phenyl or heteroaryl; $\text{YH}-(\text{CH}_2-\text{CH}_2\text{Y})_m-\text{CH}_2\text{CH}_2$, $\text{Y} = \text{O}$, or NH , $m=0-5$; N-alkylpyridinium cation, N-alkylcholinium cation, N-alkylimidazolium cation, N-alkylthiazolinium cation, etc.; $n = 1-7$;
- or of at least one asymmetric mixed salt of a dichroic anionic dye with different cations of general formula:



where:

09367543-11999

Sub
a'

Chromogene is a dye chromore system; $Z = \text{SO}_2\text{NH}$, SO_2 , CONH , CO , O , S , NH , CH_2 ; $p = 1 - 10$; $f = 0-9$; $g = 0-9$; $n = 0-9$, $m = 0-9$, $n+f = 1-10$; $m+g = 1-10$; $X, X' = \text{CO}$, SO_2 , OSO_2 , $\text{PO}(\text{O}^-\text{M}^+)$; $M \neq M_1M$, $M_1 = \text{H}$; non-organic cation of the following type: NH_4 , Li , Na , K , Cs , Mg , Ca , Ba , Fe , Ni , Co , etc.; organic cation of the following type: RHN_3 , $\text{RR}'\text{NH}_2$, $\text{RR}'\text{R}''\text{NH}$; $\text{RR}'\text{R}''\text{R}^*\text{N}$; $\text{RR}'\text{R}''\text{R}^*\text{P}$, where $\text{R}, \text{R}', \text{R}''$, $\text{R}^* = \text{alkyl}$ or substituted alkyl of the following type: CH_3 , ClC_2H_4 , HOC_2H_4 , C_2H_5 , C_3H_7 , C_4H_9 , $\text{C}_6\text{H}_5\text{CH}_2$, substituted phenyl or heteroaryl, $\text{YH}-(\text{CH}_2-\text{CH}_2\text{Y})_k-\text{CH}_2\text{CH}_2-$, $\text{Y} = \text{O}$, or NH , $k = 0-10$; heteroaromatic cation of the following type N-alkylpyridinium, N-alkylchinolinium, N-alkylimidazolinium, N-alkythiazolinium etc.;

- or of at least one associate of a dichroic anionic dye with surface-active cation and/or amphoteric surfactant of general formula:

$(\text{M}^+\text{O}^-\text{X}^-)_m [\text{M}^+\text{O}^-\text{X}'-(\text{CH}_2)_p-\text{Z}]_g \{\text{Chromogene}\} [-\text{Z}-(\text{CH}_2)_p-\text{XO}^-\text{SUR}]_r (\text{XO}^-\text{SUR})_n$, where

Chromogene is a dye chromophore system; $Z = \text{SO}_2\text{NH}$, SO_2 , CONH , CO , O , S , NH , CH_2 ; $p = 1 - 10$; $f = 0-4$; $g = 0-9$; $n = 0-4$, $m = 0-9$, $n+f = 1-4$; $m+g = 0-10$; $X, X' = \text{CO}$, SO_2 , OSO_2 , $\text{PO}(\text{O}^-\text{M}^+)$; $M = \text{H}$; non-organic cation of the following type: NH_4 , Li , Na , K , Cs , Mg , Ca , Ba , Fe , Ni , Co , etc.; organic cation of the following type: RHN_3 , $\text{RR}'\text{NH}_2$, $\text{RR}'\text{R}''\text{NH}$; $\text{RR}'\text{R}''\text{R}^*\text{N}$; $\text{RR}'\text{R}''\text{R}^*\text{P}$, where $\text{R}, \text{R}', \text{R}''$, $\text{R}^* = \text{alkyl}$ or substituted alkyl of the following type: CH_3 , ClC_2H_4 , HOC_2H_4 , $\text{C}_2\text{H}_5 - \text{C}_{10}\text{H}_{21}$, $\text{C}_6\text{H}_5\text{CH}_2$, substituted phenyl or heteroaryl, $\text{YH}-(\text{CH}_2-\text{CH}_2\text{Y})_k-\text{CH}_2\text{CH}_2-$, $\text{Y} = \text{O}$, or NH , $k = 0-10$; heteroaromatic cation of the following type N-alkylpyridinium, N-alkylchinolinium, N-alkylimidazolinium, N-alkylthiazolinium, etc.; K^+SUR^+ , $\text{SUR} = \text{KSUR}^+$, K^+SUR^+ , AmSUR , where: KSUR^+ and K^+SUR^+ are surface-active cations, AmSUR is amphoteric surfactant;

- or of at least one associate of a dichroic cationic dye with a surface-active anion and/or an amphoteric surface-active dye of general formula:

$(\text{M}^+\text{O}^-\text{X}^-)_m [\text{M}^+\text{O}^-\text{X}'-(\text{CH}_2)_p-\text{Z}]_g \{\text{Chromogene}^+\} \text{SUR}$, where **Chromogene** is a dye chromophore system; $Z = \text{SO}_2\text{NH}$, SO_2 , CONH , CO , O , S , NH , CH_2 ; $p = 1-10$; $g = 0-1$; $m = 0-1$; $m+g=1$; $X = \text{CO}$, SO_2 , OSO_2 , $\text{PO}(\text{O}^-\text{M}^+)$; $M = \text{H}$; non-organic cation of the following type: NH_4 , Li , Na , K , Cs , Mg , Ca , Ba , Fe , Ni , Co , etc.; organic cation of the following type: RNH_3 , $\text{RR}'\text{NH}_2$; $\text{RR}'\text{R}''\text{NH}$; $\text{RR}'\text{R}''\text{R}^*\text{N}$; $\text{RR}'\text{R}''\text{R}^*\text{P}$, where $\text{R}, \text{R}', \text{R}''$, $\text{R}^* = \text{alkyl}$ or substituted alkyl of the following type: CH_3 , ClC_2H_4 , HOC_2H_4 , $\text{C}_2\text{H}_5 - \text{C}_{10}\text{H}_{21}$, $\text{C}_6\text{H}_5\text{CH}_2$, substituted phenyl or heteroaryl, $\text{YH}-(\text{CH}_2-\text{CH}_2\text{Y})_k-\text{CH}_2\text{CH}_2$, $\text{Y} = \text{O}$, or

NH, $k = 0-10$; heteroaromatic cation of the following type: N-alkylpyridinium, N-alkylchinolinium, N-alkylimidazolinium, N-alkylthiazolinium, etc.; KSUR^+ (surface-active cation), $\text{SUR} = \text{ASUR}^-, \text{AmSUR}$, where: ASUR^- is surface active cation, AmSUR is amphoteric surfactant;

- or at least of one associate of a dichroic cationic dye with a surface-active cation and/or amphoteric surfactant of general formula:

$\{\text{Chromogene}\}-[\text{Z}-(\text{CH}_2)_p - \text{X}^+ \text{RR}'\text{R}'' \text{SUR}]_n$, where **Chromogene** is a dye chromophore system; $\text{Z} = \text{SO}_2\text{NH}, \text{SO}_2, \text{CONH}, \text{CO}, \text{O}, \text{S}, \text{NH}, \text{CH}_2$; $p = 1-10$; $\text{X} = \text{N}, \text{P}$; $\text{R}, \text{R}', \text{R}'' = \text{alkyl or substituted alkyl of the following type: } \text{CH}_3, \text{ClC}_2\text{H}_4, \text{HOC}_2\text{H}_4, \text{C}_2\text{H}_5, \text{C}_3\text{H}_7$, $\text{SUR} = \text{ASUR}^-, \text{AmSUR}$, where: ASUR^- is a surface-active anion, AmSUR is an amphoteric surfactant, $n = 1-4$;

- or of at least one water-insoluble dichroic dye and/or a pigment that do not contain ionogenic or hydrophilic groups;
- or of at least one low-molecular thermotropic liquid-crystal substance being a dichroic dye or containing, as a component, a liquid-crystal and/or a dichroic dye other than liquid-crystal dye and vitrified in this or other manner, for example after application of a layer by curing using ultraviolet radiation;
- or of at least on polymer material other than liquid-crystal one, with a controlled degree of hydrophilicity, dyed with a dichroic dye and/or an iodine compounds;
- or of at least one polymer thermotropic liquid-crystal and/or non-liquid crystal substance comprising solved in mass and/or chemically bonded with a polymer chain dichroic dyes;
- or at least of one dichroic dye capable of forming a lyotropic liquid-crystal phase;
- or at least of one dichroic dye of the polymer structure;
- or at least of one water-soluble organic dye capable of forming a stable lyotropic liquid-crystal phase of general formula $\{\text{Chromogene}\} (\text{SO}_3\text{M})_n$, where **Chromogene** is a dye chromophore system; $\text{M} - \text{H}^+$, a non-organic cation: and having thickness not less than 0.1 mcm;
- or of their mixes.

47. The polarizer according to claim 46, characterized in that at least one dichroic dye or pigment is selected from a series of dyes capable of forming a lyotropic liquid-crystal

09367543-1.1.1999

Sub
a'

phase, or of a series of dyes capable of forming a stable lyotropic liquid-crystal phase; or of a series of luminescent dyes; or of the direct dye class; or of the active dye class; or of the acid dye class; or of the series of sulfo-acids of polycyclic dyes; or of the type of polymethyne, cyaninic, hemicyaninic dyes; or of the type of arylcarbonic dyes; or of the type of heterocyclic derivatives of di- and triaryl methanes, or thiopyraninic, pyroninic, acrydinic, oxazininic, thiazinic, xanthenic, azinic dyes; or of the series of vat dyes; or of the series of dispersed dyes; or of the series of anthraquinonic dyes; or of the series of indigoid dyes; or of the series of mono- or polyazocompounds; or of the series of perinonic dyes; or of the series of polycyclic compounds; or of the series of heterocyclic derivatives of anthrone; or of the series of metal complex compounds; or of the series of aromatic heterocyclic compounds or their mixes.

48. The **polarizer** according to any one of claims 1-20, 25-26, 35, 37, 39, 41, characterized in that at least one birefringent anisotropically absorbing layer additionally comprises a modifier, in capacity of which modifier used are hydrophilic or hydrophobic polymers of different types, including liquid-crystalline, silicon-organic polymers; and/or plasticizers and varnishes, including silicon-organic and/or non-ionogenic surfactants.
49. A **liquid-crystal indicating element**, comprising a layer of liquid crystal disposed between a first and second plates, at least one of which plates disposed are electrodes and a polarizer, characterized in that at least one polarizer comprises at least one birefringent anisotropically absorbing layer having at least one refraction index that grows as the polarized light wavelength increases.
50. The **liquid-crystal indicating element** according to claim 49, characterized in that at least one birefringent anisotropically absorbing layer of at least one polarizer is implemented in the form of elements that differ from one another with respect of values of phase delay and/or direction of the polarization axis.
51. The **liquid-crystal indicating element** according to claim 49, characterized in that one polarizer comprises at least two birefringent anisotropically absorbing layers of different colours with mutually perpendicular directions of the polarization axes, which layers are applied one over the other, or on at least on one intermediate layer that separates them, and on the other plate the polarizer comprises at least one birefringent anisotropically absorbing layer of a grey colour having the direction of the polarization

Sub
a'

09367543 1.1.1999

axes that coincides with direction of the polarization axis of one of the birefringent anisotropically absorbing layers on the first plate.

52. **The liquid-crystal indicating element** according to any one of claims 49-51, characterized in that it further comprises on one plate a diffusion-reflection layer, which layer simultaneously serves as an electrode, and at least one birefringent anisotropically absorbing layer being disposed immediately on the reflecting layer or a dielectric sub-layer applied on the reflecting layer.
53. **The liquid-crystal indicating element** according to any one of claims 49-51, characterized in that at least one birefringent anisotropically absorbing layer of at least one polarizer has at least one refraction index that is directly proportional to the polarized light wavelength.
54. **The liquid-crystal indicating element** according to any one of claims 49-51, characterized in that at least one birefringent anisotropically absorbing layer of at least one polarizer has the thickness whereat realized is the interference extremum at output of the polarizer for at least one linearly-polarized light component.
55. **The liquid-crystal indicating element** according to claim 54, characterized in that thickness of at least one birefringent anisotropically absorbing layer of at least one polarizer satisfies the condition of obtaining, at output of the polarizer, the interference minimum for one linearly-polarized light component and the interference maximum for the other orthogonal linearly-polarized light component.
56. **The liquid-crystal indicating element** according to claim 54, characterized in that at least one polarizer comprises at least two layers, of which layers one is a birefringent anisotropically absorbing layer, and the other is the optically isotropic layer whose refraction index coincides with, or maximally proximate to one of indices of the birefringent layer.
57. **The liquid-crystal indicating element** according to claim 54, characterized in that at least one polarizer comprises at least two different birefringent layers, of which birefringent layers at least one is the anisotropically absorbing one, and one refraction index of which anisotropically absorbing layer coincides with, or maximally proximate to one of indices of the birefringent layer, and the second refraction indices of the

Sub
a1

0936543-11999

birefringent layer and birefringent anisotropically absorbing layer are different from one another.

58. **The liquid-crystal indicating element** according to claim 54, characterized in that the polarizer additionally comprises at least one layer that at least partially reflects the light.

59. **The liquid-crystal indicating element** according to claim 58, characterized in that the light-reflecting layer is a metallic layer.

60. **The liquid-crystal indicating element**, comprising a liquid crystal layer disposed between a first and second plates, at least on one of which plates disposed are electrodes and a polarizer, characterized in that at least one polarizer comprises:

- a polarizing means for dividing a plurality of non-polarized light beams of the light incident on the polarizer into the same plurality of identical pairs of differently polarized light beams, implemented in the form of focusing optical elements, each of which elements comprises at least one birefringent anisotropically absorbing layer having at least one refraction index that grows as the polarized light wavelength increases, adjacent to at least one optically isotropic layer; said polarizing means being optically registered with a means for changing polarization of at least one plurality of identically polarized light beams comprised by said plurality of pairs of differently polarized light beams.

61. **The liquid-crystal indicating element** according to claim 60, characterized in that at least one birefringent layer is implemented in the form of a plurality of volume or phase lenses.

62. **The liquid-crystal indicating element** according to claim 60, characterized in that the focusing optical element is implemented in the form of a zone plate.

63. **The liquid-crystal indicating element** according to claim 62, characterized in that the zone plate is implemented in the form of an amplitude zone plate, even zones of which comprise at least one birefringent anisotropically absorbing layer adjacent to at least one optically isotropic layer, and the odd zones are made of the optically isotropic material.

64. **The liquid-crystal indicating element** according to claim 62, characterized in that the zone plate is implemented in the form of a phase zone plate, at least one refraction

Sub
a1

093674-11999
66677-6454960

index of which phase zone plate changing along at least one of directions according to a certain rule, including in a non-monotonic manner.

65. **The liquid-crystal indicating element** according to claim 60, characterized in that the means for changing polarization comprises a sectioned translucent birefringent anisotropically absorbing layer having at least one refraction index that grows as the polarized light wavelength increases.
66. **The liquid-crystal indicating element** according to any one of claims 60-65, characterized in that the means for changing polarization is implemented in the form of a sectioned translucent half-wave birefringent plate or layer having sections disposed in focuses or outside focuses of the focusing optical elements.
67. **The liquid-crystal indicating element** according to any one of claims 60-65, characterized in that the means for changing polarization is implemented in the form of a sectioned translucent birefringent plate having sections in the form of quarter-wave plates disposed outside focuses of the focusing optical elements, and sections in the form of plates determining a phase difference between the ordinary and extraordinary rays, which phase difference differs by π from the phase difference determined by said sections in the form of quarter-wave plates disposed in focuses of the focusing optical elements.
68. **The liquid-crystal indicating element** according to any one of claims 60-65, characterized in that the means for changing polarization is implemented in the form of a sectioned translucent polymerized planar layer of a liquid crystal having the twist structure, with rotation of the optical axis of the liquid crystal within thickness of said layer at angle of 90° , with sections disposed in focuses or outside focuses of the focusing optical elements.
69. **The liquid-crystal indicating element** according to any one of claims 60-65, characterized in that the means for changing polarization is implemented in the form of sectioned translucent achromatic birefringent plate.
70. **A liquid-crystal indicating element**, comprising a layer of a liquid crystal disposed between a first and second plates, at least on one of which plates being disposed electrodes and a polarizer, characterized in that at least one polarizer is implemented in the form of at least one film or plate, whereon applied are means for converting the

Sub
a1

0936747.119660

incoming non-polarized light into a plurality of identical light beams, a polarizing means for dividing non-polarized light beams into polarized passing and reflected light beams having different polarizations, which polarizing means has at least one birefringent anisotropically absorbing layer having at least one refraction index that grows as the polarized light wavelength increases, or a birefringent layer having the constant, across the layer thickness, directions of the optical axes that change across the layer thickness according to a certain rule, and means for changing polarization and direction of the light beams reflected from the polarizing means.

71. **The liquid-crystal indicating element** according to claim 70, characterized in that the means for changing polarization and direction of the reflected light beams has a sectioned metallic mirror.
72. **The liquid-crystal indicating element** according to any one of claims 70-71, characterized in that the polarizing means comprises at least one birefringent anisotropically absorbing layer or birefringent layer having the constant, across the layer thickness, directions of the optical axes, and comprising a quarter-wave plate upstream of the sectioned metallic mirror.
73. **The liquid-crystal indicating element** according to any one of claims 70-71, characterized in comprising at least one layer of cholesteric liquid crystal as at least one birefringent layer having directions of the optical axes that change across the layer thickness according to a certain rule.
74. **The liquid-crystal indicating element** according to claims 73, characterized in that at least one layer of a cholesteric liquid crystal is made of a polymer cholesteric liquid crystal.
75. **The liquid-crystal indicating element** according to any one of claims 73-74, characterized in that at least one layer of a cholesteric liquid crystal has, across the thickness, a gradient of the cholesteric spiral pitch and, as the result, has the spectrum width of the light selective reflection band of not less than 100 nm.
76. **The liquid-crystal indicating element** according to claim 73, characterized in comprising at least three layers of cholesteric liquid crystals having the light selective reflection bands in three different spectrum ranges.

Sub
a1

09367543-11199

- Sub
a1
- 09367543-111999
77. **The liquid crystal indicating element** according to any one of claims 70-71, characterized in that the means for converting the incoming non-polarized light is implemented in the form of a system of microlenses or microprisms focusing the light beams coming out of them in the direction towards the interior of the polarizer.
78. **The liquid-crystal indicating element** according to claim 77, characterized in that the system of microlenses is implemented in the form of positive cylindrical microlenses that completely cover the surface of the polarizer.
79. **The liquid-crystal indicating element** according to claim 71, characterized in that on a first surface of a film or plate the polarizer comprises a system of microlenses and a sectioned metallic mirror optically registered with said system of microlenses, and on a second surface of a film or plate it comprises at least one layer of a cholesteric liquid crystal.
80. **The liquid-crystal indicating element** according to claim 71, characterized in that on the first surface of a film or plate the polarizer comprises a system of microlenses, a sectioned metallic mirror optically registered with said system of microlenses, and a quarter-wave plate, and on the second surface it comprises at least one birefringent anisotropically absorbing layer or birefringent layer having the constant, across the layer thickness, directions of the optical axes.
81. **The liquid-crystal indicating element** according to claim 71, characterized in that on the first surface of a film or plate the polarizer comprises a sectioned metallic mirror, and on the second surface of a film or plate sequentially applied are a system of microlenses optically registered with sections of the metallic mirror, and at least one layer of a cholesteric liquid crystal.
82. **The liquid-crystal indicating element** according to claim 71, characterized in that on the first surface of a film or plate the polarizer comprises a sectioned metallic mirror and a quarter-wave plate, and on the second surface of a film or plate sequentially applied are a system of microlenses optically registered with sections of the metallic mirror, and at least one birefringent anisotropically absorbing layer or birefringent layer having the constant, across the layer thickness, directions of the optical axes.
83. **The liquid-crystal indicating element** according to claim 71, characterized in that the polarizer comprises at least two laminated films or plates, on the external surface of a

first film or plate applied is a first system of microlenses, on the internal surface of a first or second film or plate applied is a sectioned metallic mirror, and on the external surface of the second film or plate additionally applied are a second system of microlenses optically registered with sections of the metallic mirror and with the first system of microlenses, and at least one layer of a cholesteric liquid crystal.

84. **The liquid-crystal indicating element** according to claim 71, characterized in that the polarizer comprises at least two laminated films or plates, on the external surface of the first film or plate applied is the first system of microlenses, on the internal surface of the first or second film or plate applied are a sectioned metallic mirror and a quarter-wave plate, on the external surface of the second film or plate additionally applied are a second system of microlenses optically registered with sections of the metallic mirror and with the first system of microlenses, and at least one birefringent anisotropically absorbing layer or birefringent layer having the constant, across the layer thickness, directions of the optical axes.
85. **The liquid-crystal indicating element** according to claim 71, characterized in that the polarizer comprises at least two laminated films or plates, on the external surface of a first film or plate applied is a system of microprisms, on the internal surface of the first or second film or plate applied is a sectioned metallic mirror optically registered with the system of microprisms, on the external surface of the second film or plate applied is one layer of a cholesteric liquid crystal.
86. **The liquid-crystal indicating element** according to claim 71, characterized in that the polarizer comprises at least two laminated films or plates, on the external surface of the first film or plate applied is a system of microprisms, on the internal surface of the first film or plate sequentially applied are a sectioned metallic mirror optically registered with the system of microprisms, a quarter-wave plate, on the external surface of the second film or plate applied is at least one birefringent anisotropically absorbing layer or birefringent layer having the constant, across the layer thickness, directions of the optical axes.
87. **The liquid-crystal indicating element** according to any one of claims 60-65, 70, 71, 80, 82, 84, 86, characterized in that at least one polarizer comprises at least one birefringent anisotropically absorbing layer having at least one refraction index that is directly proportional to the polarized light wavelength.

Sub
a1

0367543-1199
66TTT-4529E60

88. The liquid-crystal indicating element according to any one of claims 60-65, 70, 71, 80, 82, 84, 86, characterized in that at least one birefringent anisotropically absorbing layer of at least one polarizer has the thickness whereat realized is the interference extremum at output of the polarizer at least for one light linearly-polarized component.
89. The liquid-crystal indicating element according to claim 88, characterized in that thickness of at least one birefringent anisotropically absorbing layer satisfies the condition of obtaining, at output of the polarizer, the interference minimum for one linearly-polarized light component and the interference maximum for the other orthogonal linearly-polarized light component.
90. The liquid-crystal indicating element according to any one of claims 60-65, 70, 71, 80, 82, 84, 86 characterized in that at least one polarizer comprises at least two layers, of which layers at least one of them is the birefringent anisotropically absorbing layer, and the other is the optically isotropic layer, whose refraction index coincides with, or maximally proximate to one of indices of the birefringent layer.
91. The liquid-crystal indicating element according to any one of claims 60-65, 70, 71, 80, 82, 84, 86, characterized in that at least one polarizer comprises at least two birefringent layers, of which layers at least one of them is the anisotropically absorbing layer, one refraction index of which layer coincides with, or maximally proximate to one of indices of the birefringent layer, and the second refraction indices of the birefringent layer and birefringent anisotropically absorbing layer differ from one another.
92. The liquid-crystal indicating element according to any one of claims 49-51, 60-65, 70, 71, 80, 82, 84, 86, characterized in that at least one of the polarizers further comprises an orienting layer formed of non-organic materials, or on the basis of polymer materials.
93. The liquid-crystal indicating element according to any one of claims 49-51, 60-65, 70, 71, 80, 82, 84, 86, characterized in that at least one birefringent anisotropically absorbing layer of at least one polarizer is formed:
- of at least one organic salt of a dichroic anionic dye having general formula:
 $\{\text{Chromogene}\} - (\text{XO}^-\text{M}^+)_n$, where Chromogene is a dye chromophore system; $\text{X} = \text{CO}$, SO_2 , OSO_2 , $\text{OPO}(\text{O}^-\text{M}^+)$; $\text{M} = \text{RR}'\text{NH}_2$; $\text{RR}'\text{R}''\text{NH}$; $\text{RR}'\text{R}''\text{R}^'\text{N}$; $\text{RR}'\text{R}''\text{R}^'\text{P}$, when R, R',

Sub
a'

00367543-11000

$R'', R^{\wedge} = CH_3, ClC_2H_4, C_2H_5, C_3H_7, C_4H_9, C_6H_5CH_2$, substituted phenyl or heteroaryl; $YH-(CH_2-CH_2Y)_m-CH_2CH_2$, $Y = O$, or NH , $m=0-5$; N-alkylpyridinium cation, N-alkylchinolinium cation, N-alkylimidazolinium cation, N-alkylthiazolinium cation, etc.; $n = 1-7$;

- or of at least one asymmetric mixed salt of a dichroic anionic dye with different cations of general formula:



where:

Chromogene is a dye chromore system; $Z = SO_2NH, SO_2, CONH, CO, O, S, NH, CH_2$; $p = 1 - 10$; $f = 0-9$; $g = 0-9$; $n = 0-9$, $m = 0-9$, $n+f = 1-10$; $m+g = 1-10$; $X, X' = CO, SO_2, OSO_2, PO(O^{\cdot-}M^+)$; $M \neq M_1, M, M_1 = H$; non-organic cation of the following type: $NH_4, Li, Na, K, Cs, Mg, Ca, Ba, Fe, Ni, Co$, etc.; organic cation of the following type: $RHN_3, RR'NH_2, RR'R''NH, RR'R''R^*N, RR'R''R^*P$, where $R, R', R'', R^* =$ alkyl or substituted alkyl of the following type: $CH_3, ClC_2H_4, HOC_2H_4, C_2H_5, C_3H_7, C_4H_9, C_6H_5CH_2$, substituted phenyl or heteroaryl, $YH-(CH_2-CH_2Y)_k-CH_2CH_2-$, $Y = O$, or NH , $k = 0-10$; heteroaromatic cation of the following type N-alkylpyridinium, N-alkylchinolinium, N-alkylimidazolinium, N-alkylthiazolinium etc.;

- or of at least one associate of a dichroic anionic dye with surface-active cation and/or amphoteric surfactant of general formula:



where

Chromogene is a dye chromophore system; $Z = SO_2NH, SO_2, CONH, CO, O, S, NH, CH_2$; $p = 1 - 10$; $f = 0-4$; $g = 0-9$; $n = 0-4$, $m = 0-9$, $n+f = 1-4$; $m+g = 0-10$; $X, X' = CO, SO_2, OSO_2, PO(O^{\cdot-}M^+)$; $M = H$; non-organic cation of the following type: $NH_4, Li, Na, K, Cs, Mg, Ca, Ba, Fe, Ni, Co$, etc.; organic cation of the following type: $RHN_3, RR'NH_2, RR'R''NH, RR'R''R^*N, RR'R''R^*P$, where $R, R', R'', R^* =$ alkyl or substituted alkyl of the following type: $CH_3, ClC_2H_4, HOC_2H_4, C_2H_5 - C_{10}H_{21}, C_6H_5CH_2$, substituted phenyl or heteroaryl, $YH-(CH_2-CH_2Y)_k-CH_2CH_2-$, $Y = O$, or NH , $k = 0-10$; heteroaromatic cation of the following type N-alkylpyridinium, N-alkylchinolinium, N-alkylimidazolinium, N-alkylthiazolinium, etc.; K^+SUR^+ , $SUR = KSUR^+, K^+SUR^+, AmSUR$, where: $KSUR^+$ and K^+SUR^+ are surface-active cations, $AmSUR$ is amphoteric surfactant;

Sub
a1

09367543-111999

- or of at least one associate of a dichroic cationic dye with a surface-active anion and/or an amphoteric surface-active dye of general formula:

(M⁺O⁻X⁻)_m [M⁺O⁻X⁻-(CH₂)_p-Z-]_g {Chromogene⁺} SUR, where **Chromogene** is a dye chromophore system; Z = SO₂NH, SO₂, CONH, CO, O, S, NH, CH₂; p = 1-10; g = 0-1; m = 0-1; m+g=1; X = CO, SO₂, OSO₂, PO(O⁻M⁺); M = H; non-organic cation of the following type: NH₄, Li, Na, K, Cs, Mg, Ca, Ba, Fe, Ni, Co, etc.; organic cation of the following type: RNH₃, RR'NH₂; RR'R''NH; RR'R''R*N; RR'R''R*P, where R, R', R'', R* = alkyl or substituted alkyl of the following type: CH₃, ClC₂H₄, HOC₂H₄, C₂H₅, C₁₀H₂₁, C₆H₅CH₂, substituted phenyl or heteroaryl, YH-(CH₂-CH₂Y)_k-CH₂CH₂, Y = O, or NH, k = 0-10; heteroaromatic cation of the following type: N-alkylpyridinium, N-alkylchinolinium, N-alkylimidazolium, N-alkylthiazolium, etc.; KSUR⁺ (surface-active cation), SUR = ASUR⁻, AmSUR, where: ASUR⁻ is surface active anion, AmSUR is amphoteric surfactant;

- or at least of one associate of a dichroic cationic dye with a surface-active cation and/or amphoteric surfactant of general formula:

{Chromogene}-[Z-(CH₂)_p - X⁺ RR'R'' SUR]_n, where **Chromogene** is a dye chromophore system; Z = SO₂NH, SO₂, CONH, CO, O, S, NH, CH₂; p = 1-10; X = N, P; R, R', R'' = alkyl or substituted alkyl of the following type: CH₃, ClC₂H₄, HOC₂H₄, C₂H₅, C₃H₇, SUR = ASUR⁻, AmSUR, where: ASUR⁻ is a surface-active anion, AmSUR is an amphoteric surfactant; n = 1-4;

- or of at least one water-insoluble dichroic dye and/or a pigment that do not contain ionogenic or hydrophilic groups;
- or of at least one low-molecular thermotropic liquid-crystal substance being a dichroic dye or containing, as a component, a liquid-crystal and/or a dichroic dye other than liquid-crystal dye and vitrified in this or other manner, for example after application of a layer by curing using ultraviolet radiation;
- or of at least on polymer material other than liquid-crystal one, with a controlled degree of hydrophilicity, dyed with a dichroic dye and/or an iodine compounds;
- or of at least one polymer thermotropic liquid-crystal and/or non-liquid crystal substance comprising solved in mass and/or chemically bonded with a polymer chain dichroic dyes;

Sub
a1

09367543-111999

- or at least of one dichroic dye capable of forming a lyotropic liquid-crystal phase;
- or at least of one dichroic dye of the polymer structure;
- or at least of one water-soluble organic dye capable of forming a stable lyotropic liquid-crystal phase of general formula {Chromogene} (SO₃M)_n, where Chromogene is a dye chromophore system; M - H⁺, a non-organic cation; and having thickness not less than 0.1 mm;
- or of their mixes.

94. The liquid-crystal indicating element according to claim 93, characterized in that at least one dichroic dye or pigment is selected from a series of dyes capable of forming a lyotropic liquid crystal phase, or of a series of dyes capable of forming a stable lyotropic liquid-crystal phase; or of a series of luminescent dyes; or of the direct dye class; or of the active dye class; or of the acid dye class; or of the series of sulfo-acids of polycyclic dyes; or of the type of polymethyne, cyaninic, hemicyaninic dyes; or of the type of arylcarbonic dyes; or of the type of heterocyclic derivatives of di- and triaryl methanes, or thiopyraninic, pyroninic, acrydinic, oxazininic, thiazinic, xanthenic, azinic dyes; or of the series of vat dyes; or of the series of dispersed dyes; or of the series of anthraquinonic dyes; or of the series of indigoid dyes; or of the series of mono- or polyazocompounds; or of the series of perinonic dyes; or of the series of polycyclic compounds; or of the series of heterocyclic derivatives of anthrone; or of the series of metal complex compounds; or of the series of aromatic heterocyclic compounds or their mixes.

95. The liquid crystal indicating element according to any one of claims 49-51, 60-65, 70, 71, 80, 82, 84, 86, characterized in that at least one birefringent anisotropically absorbing layer of at least one polarizer further comprises a modifier, in capacity of which modifier used are hydrophilic or hydrophobic polymers of different types, including liquid crystalline, silicon-organic polymers; and/or plasticizers and varnishes, including silicon-organic and/or non-ionogenic surfactants.

Add
a² → Add C3 → Add D3

Sub
a¹

09367543-11999